Research and Development Projects
for Young Researchers

MODULAR GREEN WALLS (MODGREW)

Goal of the project

The goal of the project is based on studies of natural elements` response to external stimuli. The study of modular green/vegetated wall systems aims to determine optimal responsive surface organizations, while testing materials and geometry in various conditions. The project uses digital modelling based on algorithms for simulation and testing of prototypes.

Short description of the project

MODGREW, modular green wall, is an interactive system that reacts to external stimuli.

Implementation period

01.02.2019 – 15.06.2020

Budget

47.600 RON (10000 EUR)

Main activities

- The green installation concept is made out of interactive modular systems, creating a new, living, dynamic, interactive structure whose inspiration is taken from nature while using biomimicry as main principle for its development. This new concept responds and is influenced by external, natural stimuli or by the human factor. We added a new direction to the research in order to use simple materials (wood/ pvc) that react to external environmental stimuli (humidity, light, movement). We aim to use the minimum required sensors to supplement certain actions in a simple "natural" manner.
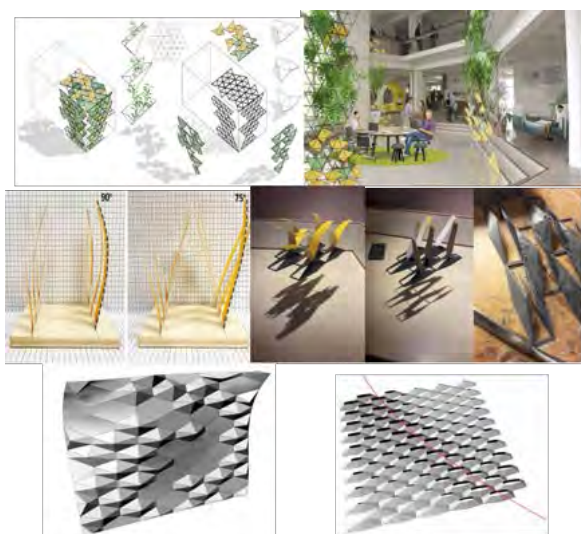
Results

- The presentation of the research results is done in specific international conferences and articles written for journals and symposiums. Their materialization involved the realization prototypes at different scales.
- The estimated impact of the project in the scientific context can be significant in the direction of transforming a simple support for plants into an interactive mechanism that takes into account the natural growing needs of the sustained plants. Inspired by nature, and how plants and simple materials react to external light, temperature and humidity, the proposed interactive structure acquired an exterior skin to optimize environmental interaction.

Applicability and transferability of the results:

This new architectural concept inspired by kinetic and biomimetic design, represents an innovative approach to existing environmental elements, opening new directions of research.

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PREDICTION AND MANAGEMENT OF URBAN TRAFFIC CONGESTION USING MACHINE LEARNING

Goal of the project

The project intends to develop reliable methods of predicting urban traffic congestion in Timisoara, using machine learning methods and tools with emphasis on "random faults" in transportation networks: what happens when there is a traffic accident during rush hour and how could we mitigate the impact by using adaptive traffic signaling plans.

Short description of the project

Using historic data and traffic microsimulation we train a model for predicting the impact of traffic accidents over the transportation network of Timisoara

Implementation period

01.02.2019 – 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

1. Technical activities consist of collection and aggregation of pertinent data regarding the state and quality of traffic on all the segments of the area under study. Each set of data is manually annotated with data regarding traffic incidents and special circumstances (road closure, flow deviation etc.).

2. Next, we use the data for training a machine learning model and use the resulting model for predicting, short time horizon, of up to 30 minutes, the flow of traffic in the adjacent area of the incident.

3. Scientific activities consist of presenting the results of our work a relevant conference (2 international conferences) and publishing in relevant journals.

Results

- At the current stage of the project we have ingested full data regarding Timisoara, over the last 215 days (12 samples/hour=61920 samples) and have annotated the sets with relevant metadata: weather, holydays, public events and traffic incident data (trought the partnership with the local authorities).provide us with the means for advancing towards the final goal of the project

- The main issue we found is the scarcity of the data for a thorough training of the machine learning model, consequently we developed a framework for generating large sets of data trough traffic micro-simulation, using PTV Vissim, under a large variety of circumstances. The results of this stage are going to

Applicability and transferability of the results:

The results of the project have direct applicability to the improvement of the quality of transportation in Timisoara. We already have a fruitful collaboration with the city's transportation authorities and traffic management control. Available results are going to be first used for cross-validating actions during minor traffic incidents while input from the stakeholders is used in fine-tuning the algorithm

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BIOREACTOR FOR CONTROLLED/ADVANCED DEGRADATION OF POLYMERIC MATERIALS

Goal of the project

The main goal of the project is the development and implementation of an innovative technology that would reduce the impact of plastic waste onto environment. In this respect, a new technology of degradation based on a laboratory scale aerobic bioreactor will be designed. Plastic waste will be fed inside the bioreactor and would provide the carbon source necessary for the proliferation of bacteria. The polymeric material will be turned into compost after this biodegradation step, and would no longer be a threat for the environmental equilibrium.

Short description of the project

New technology of polymeric materials biodegradation inside a self-designed bioreactor fed with natural occurring bacteria or pure culture inocula. The biodegradation will take place in aerobic conditions, under continuous stirring and thermoset temperature, which allows the formation of microbial consortia.

Implementation period
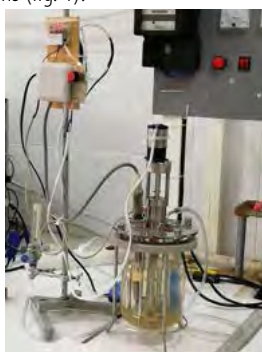
01.02.2019 – 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

• A1.1. Design and testing of laboratory scale bioreactor. Process control parameters: temperature and pH.

The Bioreactor is made up of a sealed glass tank, with continuous stirring, thermoset unit, aeration device, sampling ports and pH monitoring systems (fig. 1).

• I.2. Air pumping system calibration. CO2 monitoring system

The air flow is provided by an air compressor and adjusted by means of a flowmeter. The air could be conducted through a HEPA filter system. The carbon dioxide is measured by an IR sensor mounted inside a separate cell.

• I.2. Air pumping system calibration. CO2 monitoring system

The air flow is provided by an air compressor and adjusted by means of a flowmeter. The air could be conducted through a HEPA filter system. The carbon dioxide is measured by an IR sensor mounted inside a separate cell.

Results

• The tested glycopolymer displayed good biodegradation pattern inside the bioreactor. The weight loss was measured from time to time and kinetic modeling was performed in order to foresee the operating performances of the bioreactor. TG and FTIR analyses confirmed the structural modification of the glycopolymer samples during biodegradation. These findings were published as ISI articles and conferences.

Applicability and transferability of the results:

• 1. Pană A.M., et al.., Biodegradation studies on new glycopolymers derived from oligomeric D-mannose itaconates and 2-hydroxypropyl acrylate, Polym Degrad Stabil, 2019, 167, 210-216, I.F. = 3,78
• 2. Pană A.M., et al. Preliminary study on polymer degradation using an aerobic reactor, J Environ Prot Ecol, 2019, 20(4), 1951-1959, IF = 0.25
• 3. Pană A.M., et al.., Efficiency of an Aerobic Bioreactor for Glycopolymer Biodegradation, Proceedings of 9th International Conference on ENERGY and ENVIRONMENT (CIEM), IEEE Xplore, 2019, 129-132
• 4. Pană A.M., et al.., Preliminary study on polymer degradation using an aerobic reactor, Environmental Engineering and Sustainable Development, 7th Edition, June 20-21th, Alba Iulia.
• 5. Roman R., Pană A.M., Dumitrel G.A., Studii preliminare a biodegradării unor polimeri zaharidici utilizând un bioreactor aerob, Simpozionul Științific Studențesc al Facultății de Chimie Industrială și Ingineria Mediului, ediția a III-a, 14 Iunie 2019.

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MODERN PHOTOGRAMMETRIC TECHNOLOGIES UTILIZED IN BITUMINOUS LAYER MONITORING

Goal of the project

The project presents solutions, sustained by case studies, regarding the geospatial data acquisition, processing and interpretation using modern photogrammetric technologies in bituminous layer monitoring.

Short description of the project

The project' two main objectives are: regular monitoring of the bituminous garment degradation status evolution and thermal regime evaluation in a bituminous garment at certain time intervals.

The project proposes the degradation status evolution monitoring and the thermic regime evaluation for a bituminous layer, during its execution, using images acquired with a UAV.

Implementation period

01.02.2019 - 31.07.2020

Budget

49.200 RON

Main activities

For the degradation status evolution assessment there are provided two flights at intervals of six months between them, in order to determine the type and extent of the defects from the surface of a bituminous layer, as well as the clogging state of the clogging devices.

The flights, aimed at determining the thermal regime, are performed on the same day on a sector on which a bituminous layer is realized.

Three values will be obtained: at the time of mixing, at the beginning of the compaction and at the end of the works. Also, based on the obtained depth results, a temperature profile on the executed layer thickness will be drafted.

Results

The geospatial and thermal data collected on the experimental sectors were analyzed, processed and georeferenced, obtaining specific photogrammetric products (i.e. DSM - Digital Surface Model), and information regarding the bituminous layer temperature when it is put into operation (squeezing, compacting, commissioning).

DSM - Digital Surface Mode - Visual Vision
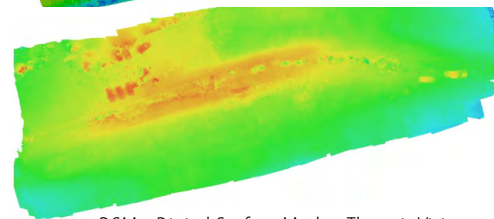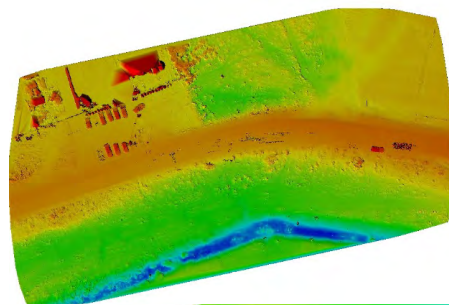
DSM - Digital Surface Mode - Thermic Vision

Applicability and transferability of the results:

Following the correlation of both the results obtained by classical methods (the temperatures determination by direct measurements made on the field and the degradation state evaluation using measurements made on the field) and the results obtained after processing, the method used in this project is more accurate and economical, representing a progress in the field of communication ways.

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OBTAINING AND CHARACTERIZATION OF BULK AMORPHOUS ALLOYS WITH BIOCOMPATIBLE PROPERTIES

Goal of the project

The goal of the project is to propose new chemical composition and processing methods in order to obtain bulk amorphous alloys with biocompatible properties.

Short description of the project

The project's purpose is to develop new amorphous structured materials for biomedical devices.

Implementation period

01.02.2019 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

During this project, the research team was focused on the following activities:
- Optimizing of a chemical composition that ensures high amorphization capacity;
- Processing of bulk amorphous alloys (rods and discs);
- Characterization of the obtained alloys regarding their structure and properties (DTA analysis, X-Ray diffraction, hardness testing, wear and corrosion resistance).

Results

Estimated results include:
- processing of a bulk amorphous alloy, with a chemical composition that ensures high biocompatibility and amorphization capacity;
- casting and processing technology of bulk amorphous alloys for biomedical devices (fixing plates rods);
- obtaining high quality new bulk amorphous alloys with applicability in the field of medical engineering.

Applicability and transferability of the results:

- The success of the research will open the way to obtain new materials with amorphous structure and improved properties, usable to produce different parts in the field of medical engineering.

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NONLINEAR CONTROLLERS WITH PARAMETERS TUNED USING EXPERIMENTS, DEDICATED TO AERODYNAMIC SYSTEMS

Goal of the project

Analysis, design and implementation of control solutions with nonlinear controllers: fuzzy control techniques mixed with other nonlinear techniques: VRFT, MFC, MFAC, ADRC and SMC in order to improve the control system (CS) performance and validate the new CSs with the proposed nonlinear controllers through experiments on laboratory equipment.

Short description of the project

Nonlinear controllers whose parameters are tuned using experiments are developed.

## Implementation period

01.02.2019 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

Main activities
1. Development of nonlinear controllers.
2. Combination of fuzzy logic with VRFT, MFC, MFAC, ADRC and SMC.
3. Deriving a mechanism to ensure the stability of CSs with nonlinear controllers in the frameworks of data-driven and fuzzy control.
3. Validation of the controllers on real-world processes in the labs of the research team.
4. Publication of results in visible conference and journal papers.
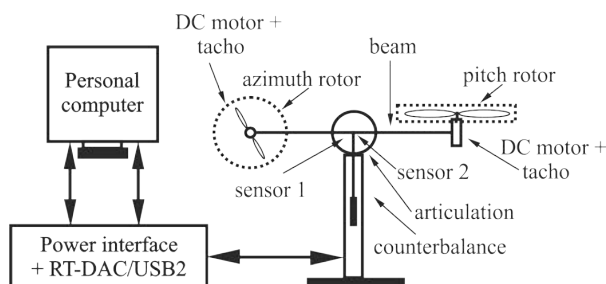
Results

The research team published one journal paper indexed in Clarivate Analytics Web of Science (WoS, with one of the previous names ISI Web of Knowledge) (link), impact factor = 2.707 according to Journal Citation Reports (JCR) published by Clarivate Analytics in 2018 in the gray zone (Q3) of the Energy & Fuels category.

Results - continuation

The research team published three conference papers currently indexed in the international data bases IEEExplore (link and link) and ScienceDirect (link). The proceedings of the previous editions of these conferences are indexed in WoS.
The last mentioned paper received Best Paper Award (link) at 7th International Conference on Information Technology and Quantitative Management ITQM 2019 (Granada, Spain).

Applicability and transferability of the results:

With the support of our partner from the University of Ottawa, the new CSs with nonlinear controllers presented in Energies journal and at 2019 IEEE International Conference on Systems, Man, and Cybernetics (SMC) are in the validation process at Ontario Centers of Excellence.

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MODERN SOLUTIONS FOR STRENGTHENING FLAT SLABS, VALIDATED THROUGH NUMERICAL, PROBABILISTIC AND EXPERIMENTAL RESEARCH

Goal of the project

The goal of the project is to identify and validate modern and viable solutions for strengthening of deficient slab-column connections of reinforced concrete flat slabs. Another important objective, given the high applicability of the results, is represented by the enhancement of knowledge in the field and efficient dissemination and transfer of know-how towards third parties and industry.

Short description of the project

The study proposes solutions for enhanced punching shear capacity of reinforced concrete flat slabs.

Implementation period

01.02.2019 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

- The main activity of the project resided in the experimental program that consisted of four tests performed on full-scale specimens reproducing slab-columns connections inside reinforced concrete flat slabs. The tests aimed to reveal the behavior of such specimens and to validate the proposed strengthening solutions.

- The theoretical research approached methods used in order to numerically simulate the non-linear behavior of such slabs. Probabilistic methods were enabled in order to identify the parameters that impact the performance of the system and that of proposed strengthening solutions.

Results

- The capacity enhancement provided by the technique that uses high-performance fiber reinforced mortar is considered a very important result, as this technique is extremely technologically feasible. This facility of application is in contract to the most existing techniques which have been proven to be applied in a cumbersome manner.
- The very good agreement between tests and numerical models proves that a stable solution for simulating the behavior of such structural elements was achieved. The numerical parametric study also gave vital information on the effectiveness of strengthening techniques.

Applicability and transferability of the results:

As flat slabs are quite in-fashion with civil engineers for newly designed multi-storey structures and the design and execution flaws are becoming relatively common, the results of the research are highly applicable for both designers and constructors worldwide. The industry will benefit by publishing of research results in highly visible scientific publications and professional meetings.

Research team

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EFFICIENT THREE-PHASE RECTIFIERS ENSURING UNITARY POWER FACTOR IN INDUSTRIAL APPLICATIONS

Goal of the project

The goal of the project is to ensure high energy efficiency, reduction of the current and voltage fluctuations from the output of the rectifier, respectively the conformity of the harmonics up to order 40 to the international standard IEC 61000-3-2.

Short description of the project

The aim of this research is to build the Vienna PFC rectifier topology.

Implementation period

01.02.2019 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

A.1. Analysis of the actual state of the art of the three-phase rectifiers able to provide unitary power factor in industrial applications.

A.2. Theoretical study through modeling and simulation of the chosen topology.

A.3. Dissemination of the results.

A.4. Defining the data and the design framework of the chosen topology.

A.5. Analytical design of the rectifier: choosing, sizing, checking components.

A.6. Modeling/simulation/rectifier structure optimization.

A.7. Design and purchase of PCBs.

A.8. Purchase of components/equipment necessary for the construction/testing of the rectifier.

Results

- A comprehensive study of the PFC rectifier topologies existing in the specialized literature was carried out. From this study, 6 topologies were chosen. These were modeled and simulated. One of the 6 topologies was chosen for practical purposes. Then, rectifier design framework was defined, followed by its analytical design, namely the selection, dimensioning and verification of the components.
- The activities of optimizing the structure of the rectifier and designing the printed circuit boards (PCBs) followed.

- The latter (PCBs) and the electrical components necessary for the practical realization of the rectifier and the equipment for testing the rectifier were purchased. Then, the physical components were glued to the PCBs, resulting the physical rectifier, as shown in the below figure.
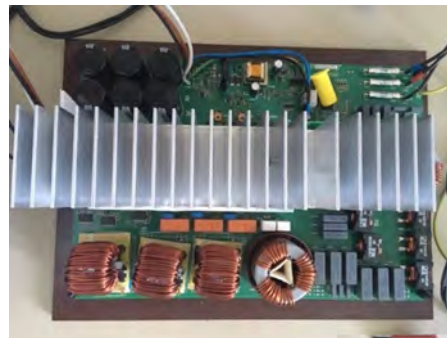
Applicability and transferability of the results:

It is typical for large industrial users to be penalized for one factor of net power less than 1, as they directly affect the distribution losses for a utility company. This can be prevented by correcting the power factor in this way so that the electricity grid works efficiently, the cost of power generation reducing, resulting in a saving of money for both the utility company and customers.

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DEHAZING DATASETS AND TECHNIQUES TO EVALUATE CLASSIFICATION METHODS

Goal of the project

We aim to introduce several dehazing techniques and to build a dehazing dataset which can be used for testing and evaluation the effectiveness of existing classification techniques in the context of dehazing. The dehazing dataset will contain real reference and hazy images of the same scene recorded under the same illumination conditions. Based on these dehazing dataset, we will perform an extensive assessment of the existing dehazing methods.

Short description of the project

Development of image dehazing techniques and recording of realistic image dehazing dataset.

Implementation period

01.02.2020 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

1. Developing state-of-the art image dehazing techniques.
2. Recording of a realistic image dehazing dataset which can be used for testing and evaluation the effectiveness of existing classification techniques in the context of dehazing.
3. Evaluation of the recent image dehazing techniques.

Results

• We introduced/published a realistic image dehazing datset:
1. Codruta O Ancuti, Cosmin Ancuti, Radu Timofte, Luc Van Gool, Lei Zhang, Ming-Hsuan Yang „", Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, Long Beach, US, June 2019;
2. Codruta O Ancuti, et al „Dense haze: A benchmark for image dehazing with dense-haze and haze-free images", IEEE International Conference on Image Processing, Taipei, Taiwan, sept. 2019.

• We introduced several sota image dehazing/enhancement techniques:
1. Codruta O Ancuti et al., „Color Channel Transfer for Image Dehazing", IEEE Signal Processing Letter , (Q1, impact factor 3.268).
2. Codruta O Ancuti, et al., „Color Channels Compensation (3C): A fundamental pre-processing step for image enhancement", IEEE Transactions on Image Processing , (Q1, impact factor 6.79).

Applicability and transferability of the results:

Outdoor traffic scenes images often suffer from poor visibility introduced by haze. Haze is a common atmospheric phenomena produced by small floating particles that absorb and scatter the light from its propagation direction.

Due to attenuation and scattering, hazy scenes are characterized by poor contrast of distant objects, color shifting, and additional noise.

The outcome of this project is important for computer vision ADAS module in the automotive industry.

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EMBEDDED SOLUTIONS FOR DEEP NEURAL NETWORKS

Goal of the project

The goal of the project is to develop a technical solution that allows automatic transfer of Deep Neural Networks to dedicated embedded systems. Appropriate neural models need to be chosen in order to fit the specific requirements and limitations of an embedded system. At the same time, a suitable embedded platform needs to be chosen to accommodate all the necessary computational structures of a neural network and to satisfy the power constrains to the application.

Short description of the project

The project aims to insert Artificial Intelligence specific methods into the automotive applications.

Implementation period

01.02.2020 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

1. Identifying and studying the different types of deep neural networks: CNN-Convolutional Neural Networks, RNN-Recurrent Neural Netwoks, DBN-Deep Belief Networks
2. Choosing an appropriate development framework: Tensorflow (Keras), Caffe, Matlab
3. Developing and automotive specific application: traffic sign detection, pedestrian detection, drowsiness detection.
4. Studying the available embedded solutions and choosing the appropriate one.
5. Studying the computational limitations introduced by the hardware constrains.
6. Developing a deployment tool.
7. Testing and validating the results.

Results

1. Convolutional Neural Networks (CNN) and PointNet have been found to best fit automotive applications. These nets are also portable and can run on embedded systems.
2. Both Tensorflow and Keras are suitable for developing network architectures, training and testing the networks. MATLAB is also useful for preprocessing data.
3. Two automotive applications have been developed: traffic sign detection using CNN; driver hand gesture recognition using a 3D ToF (time of flight) camera and a 3D PointNet;
4. The best embedded system to run the applications was Google's Coral DevBoard, with TPU accelerator to efficiently run tensor operations.

Applicability and transferability of the results:

- The results are directly applicable in the automotive industry.
- Both the traffic sign recognition and hand gesture recognition applications improve driver-car interaction and so driving safety.

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MEASUREMENT OF EXPOSURE TO LOW FREQUENCY ELECTROMAGNETIC FIELDS NEAR HIGH VOLTAGE POWER INSTALLATIONS - EXCEM

Goal of the project

The main goal of this project is to obtain information on the actual values of the intensity of the electrical component and the induction of the magnetic component, related to the low frequency electromagnetic fields (1-300Hz, including harmonics) in the vicinity of medium or high voltage installations or equipment, in order to mitigate their effects. on human personnel or environment.

Short description of the project

Measurements are made in stations, near transformers, switches or other MV/HV equipment or lines.

Implementation period

01.02.2020 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

- Main research activities are:

-Purchase of measuring equipment and software.

1. Establish, together with the Plant Owner, the specific measurement procedures.

2. Performing field measurements.

3. Carrying out measurements in transformer stations and stations.

4. Making measurements on power lines.

5. Statistical processing of results.

6. Drawing up conclusions and recommendations.

7. Dissemination of research results.

The measurements concern the intensity of the electric field (kV / m) as well as the magnetic induction (T), carried out in accordance with Directive 2014/30/EU and other specific regulations.

Results

- According to a partnership with the National Power Grid Operator, Transelectrica most of our measuring activities were performed at the Fantanele, Iernut and Sibiu Sud Power Stations, belonging to the Sibiu Branch, as well as at some Timisoara Branch stations, around bus-bars, transformers, autotransformers, switchers, surge arresters, circuit breakers, at temperatures between 15 and 25 degrees Celsius, both for the Electric Field Intensity and Magnetic Field Induction.

- We can consider that all the recorded values are placed under the maximum 10 kV/m (1 mT) admissible level for permanent human exposure. or smaller than the maximum 20kV/m (3 mT) short time exposure limit. By taking in consideration all these facts, a lot of additional safety measures are not required or mandatory

Applicability and transferability of the results:

- The purpose of these measurements is an informal one, giving a real and objective image (by involving impartial academic staff), about the existing values. All data resulted from this project will be communicated exclusively to the owner of the objective generating MV/HV electromagnetic fields (ex. Transelectrica), together with a set of conclusions and recommendations of an informal character.

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THE INFLUENCE OF PROCESS PARAMETERS ON PROPERTIES OF SAMPLES OBTAINED BY ADDITIVE MANUFACTURING

Goal of the project

The main goal of the project was to establish analytical correlations between the input process parameters and the outcome properties of samples obtained by selective laser sintering.

Short description of the project

The project approaches an exploratory research that fit in additive manufacturing field, particularly on Selective Laser Sintering (SLS). Using SLS technology, samples were manufactured under various conditions. By inspecting and mechanical testing, important findings in process parameter-property relation were identified.

## Implementation period

01.02.2020 - 15.06.2020

Budget

47.600 RON (10000 EUR)

Main activities

• Geometric model design according to ISO 527-1:2012(en) and ASTM D 5045-14 standards.
• Sample manufacturing by SLS under rational selection of process parameters.
• Inspection of dimensional accuracy of samples and microstructure investigation.
• Mechanical testing: tensile, bending and fracture mechanics.
• Data analysis by statistical tests (Pearson's correlation, Covariance, ANOVA)
• Process parameters – geometric and mechanical properties relation.

Results

• One hundred Polyamide (PA2200) samples were manufactured using two process variables: Orientation angle (OA) and Energy density (ED).
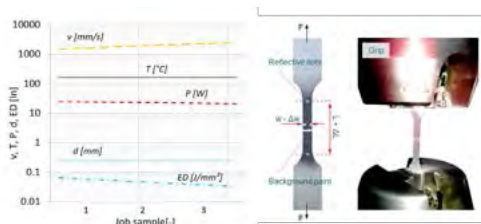
• Tensile tests on standard samples reveal the following behavior: energy density produces direct consequences on mechanical properties, an ED<0.06 J/mm2 leading to unacceptable strength values. The proper OA for the best tensile strength is 45° in X-Y plane.
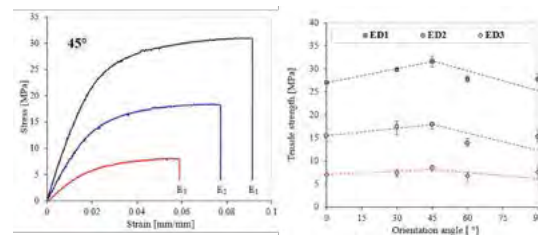
Identic process parameters were used to manufacture rectangular section samples. The 3P-bending tests were conducted on un-notch and notched samples in order to underline the bending strength and fracture toughness.

The geometrical results on these samples reveal a high dimensional error (up to 9%) on vertical direction (Z axis). Also, on this direction of growing the best density was recorded.

Pearson's correlation reveals strong positive relationship of density and KIC with ED and OA. The best fracture toughness value was determined for vertical orientation (Y-Z plane) and for highest ED, as the above diagrams indicates.

Applicability and transferability of the results:

The research results are addressed to manufacturing engineering field and they provide important information on how the process parameters are influencing the mechanical and geometrical properties of the parts. Relying on this information, the SLS process parameters can be set to obtain reliable results. Also, design restrictions for additive manufacturing process and samples virtual arrangement in the building envelope can be specified based on research data.

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MITIGATION OF PRESSURE PULSATIONS FROM THE CONICAL DIFFUSER USING THE PULSATING JET DEVICE

Goal of the project

The aim of this project is to focus on the influence of the pulsating jet on the dynamic and energetic performances of the conical diffuser, when the hydraulic turbines operate on a wide range of regimes. Thus the purpose of the initiative is: the safe extension of the operating regime of turbines or pump-turbines, by reducing or eliminating the self-induced non-stationarity of the flow with rotation, with the associated effects - noise, vibration, mechanical and dynamic loads. The project does not necessarily address the method itself, but rather its fundamentals, for a better understanding of the mechanism and effects of the pulsating water jet, in turbines and turbine pumps.

Short description of the project

The fundamental problem to which this project is addressed is the study at several operating regimes of a new method of controlling the decelerated swrling flow, with helical swirl. The new method consists of axial injection of a pulsating water jet along the axis of the suction tube of the hydraulic turbines, in order to reduce the pressure oscillations due to the swirling flow that appears at operating regimes far from the optimum one.

Implementation period

01.02.2020 - 15.06.2020

Budget

47.600 RON (10000 EUR)

Main activities

- 01. Experimental investigations with and without pulsating jet.

A.1.1. Implementation of the variable speed system, for obtaining different operating regimes of rotational flow

A.1.2. Testing the pulsed jet method at 5 operating modes

- 02. 3D numerical analysis of the swirling flow at different operating regimes with and without a pulsating jet

A 2.1. 3D numerical analysis at 5 operating modes with pulsed jet

A. 2.2. Comparison of numerical data with experimental data.

Results

Thus, during the first phase of the project, the numerical analysis of the 3D flow at different operating points of the turbine was analyzed, with and without the technique of water injection with pulsating jet. The numerical analysis was performed using the FLEUNT expert software from ANSYS 16.2. The qualitative images of the velocity field below, obtained from the numerical simulation, show clearly that, with the introduction of the pulsating water jet along the axis of the conical diffuser, the helical vortex disappears, including the pressure pulsations associated with it, which damages the turbine.

- All the results can be found published in articles:
- C. TANASA, A. Bosioc, A. Stuparu and R. Susan-Resiga, "Numerical Analysis of Pulsating Water Jet Method in a Conical Diffuser at Different Operating Regimes", CIEM 2019, published IEEE.

- C. TANASA Adrian STUPARU, Catalin STROITA, Constantin POPESCU and Romeo SUSAN-RESIGA, (2019), 3D Numerical Analysis of Pulsating Water Jet in the Draft Tube Cone of Hydraulic Machinery, ICCMSE, Rhodos, Greece, AIP conference Proceedings, 2186.
- A. Bosioc, C. Tanasa*, 2020, Experimental study of swirling flow from conical diffusers using the water jet control method, Renewable Energy, 152, p.385-398. https://doi.org/10.1016/j.renene.2020.01.08
- C. Tanasa, A. Bosioc, S. Muntean, R. Susan-Resiga, 2019, A Novel Passive Method to Control the Swirling Flow with Vortex Rope from the Conical Diffuser of Hydraulic Turbines with Fixed Blades, Appl.Scienc., 9 (4910).
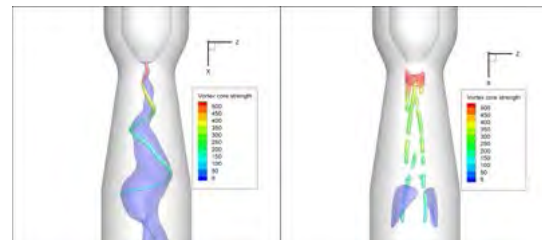
Applicability and transferability of the results:

The method to be tested on the experimental stand will be proposed for use on real hydroelectric power plants from the national electricity company SC Hidroelectrica SA Romania, which is a partner of UPT in different contracts in the field of hydraulic machines.

Research team

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ORGANIZATIONAL CAPACITY ASSESSMENT FOR SUSTAINABLE DEVELOPMENT IN THE CONTEXT OF CIRCULAR ECONOMY (ECOSEC)

Goal of the project

The project aims to develop a web platform that integrates a tool for organizational evaluation and to provide a laboratory with evaluation equipment. The tool contributes to diagnosing the capacity of organizations for sustainable development, elaborates a personalized strategic plan of action to respect the principles of the circular economy and develops a manual for self-training that contributes to the improvement of the current situation.

Short description of the project

The project integrates sustainability and circular economy in order to develop an evaluation tool.

Implementation period

01.02.2020 – 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

The main activities are:
- Organizing knowledge for sustainability and circular economy
- Development of the tool for organizational evaluation
- Equipping a laboratory called EcosEc
- Dissemination of results in prestigious journals and scientific events.
- The elements of originality that the project brings are:
- the diagnosis made in an integrated way by considering GRI indicators and standards
- generates for each organization a strategic action plan to correct the deficient activities
- a manual for self-training, personalized, according to the degree of maturity
- creates a laboratory for organizational evaluation on sustainable development, provided with equipment and 5 trained evaluators.

Results

The results of the project are:
- Project identification through promotional materials
- Development and equipment of the laboratory called EcosEc (1 projector, 10 tablets, 2 laptops, 1 mini-library, teaching materials from recycled paper)
- Meetings with companies to identify indicators for evaluation
- Development knowledge maps to identify the organizational profile
- Publication of a manual for organizational self-training after evaluation
- Identifying the profiles and needs of businesses and economic opportunities
- Promotion of the evaluation tool in the business environment (over 9 appearances)
- Publication of 18 articles:
- 3 articles in journals with quartile Q2, Q3 and WOS
- 9 articles at WOS indexed conferences
- 6 articles in BDI indexed journals
- Training of 5 trainers
- Training of more than 20 masters

Applicability and transferability of the results:

The project is based on the development of a tool for assessing the sustainability and deficiencies that can be applied in different companies.
- The developed tool can be used on companies from different fields of activity. It can be customized for other areas of activity.
- The instrument is used in laboratories of the faculty. It can be used by other fields of study.

Research team

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QUALITATIVE STUDY OF EVOLUTION EQUATIONS AND APPLICATIONS TO DYNAMICAL SYSTEMS

Goal of the project

The main goal of the project is to characterize the nonuniform behavior for evolution equations in infinite-dimensional spaces and to apply the theoretical results in the study of a class of Euler equations.

Short description of the project

We characterize nonuniform (exponential) stability and nonuniform dichotomy in terms of evolution semigroup and admissibility method.

Implementation period

01.02.2020 - 15.06.2020

Budget

47.600 RON (10000 EUR)

Main activities

The research team was focus on the following activities:

- Definition of the evolution semigroup in the context of nonuniform behavior and characterization of nonuniform exponential stability in terms of invertibility of the corresponding infinitesimal generator.

- For an arbitrary noninvertible evolution family and for a large class of rate functions, we characterize to notion of general dichotomy in terms of two admissibility conditions. As a nontrivial application of our work, we establish the robustness of general dichotomies.

- Study of the local well-posedness in the smooth category for a class of Euler-Arnold equations.

Results

The main results of the project were published in:

- N. Lupa, L.H. Popescu, Admissible Banach function spaces and nonuniform stabilities, accepted in Mediterranean Journal of Mathematics (ISI journal, IF 1.181)

- E.C. Cismas, N. Lupa, A Nash-Moser approach for the Euler-Arnold equations, Monatshefte für Mathematik, DOI 10.1007/s00605-019-01344-z, 2019 (ISI journal, IF 0.807)

- D. Dragičević, N. Jurčević Peček, N. Lupa, Admissibility and general dichotomies for evolution families, submitted to Asymptotic Analysis (ISI journal, IF 0.808)

Applicability and transferability of the results:

By allowing growth rates that are not exponential, we are considered situations where the Lyapunov exponents can be zero, and since we do not need to assume the invertibility of the evolution families on the whole Banach space, our results can be applied to a large class of dynamical systems, in particular to equations defined by compact operators on infinite-dimensional spaces.

Research team

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DESIGN OF A MODULAR MECHATRONIC DEMONSTRATOR WITH VIDEO FEEDBACK FOR CONTROL ALGORITHMS OPTIMIZATION

Goal of the project

The starting point of this research project is the insight that a human does not have a kinematic model of his arms, but still executes manipulation tasks efficiently in unstructured spaces, compared to the classic approach on robotic manipulation where a model of the arm must exist.
The goal of our project is to explore the human-like manipulation, where the control system does not have a model of the arm, but relies on vision and machine learning.

Short description of the project

The project aims at using video feedback and machine learning for robotic manipulation

Implementation period

01.02.2020 - 31.07.2020

Budget

47.600 RON (10000 EUR)

Main activities

The main activities in the project are:
- Development of the Mechatronical structures to be controlled
- Development of the control algorithms
- Testing
- Publishing of results in Proceedings and Journals
- Participation at Conferences
- Participation at Workshops
- Construct the project website:
- https://arut-mecatronix.weebly.com
- Project Management

Results

- To achieve our goal, we designed a modular structure to accommodate various types of manipulators (serial, parallel), and with the help of an overlooking video camera, to control the system.

In the above figure is presented an example of a mechatronic structure to be controlled.
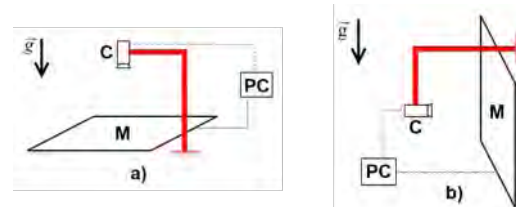

Figure a) and b) show the general system setup which incorporates the Mechatronic system, video camera and controller PC.
Along the constructed system, experimental results were published in ISI Web of Science.
The main result of the project is the construction of a test-bed for various mechatonic structures and control algorithms that is available in the Mechatronics Department to any researcher interested in this type of research.
The research areas of the project are: robotics, mechatronic design, algorithm design and development, machine vision, machine learning and artificial intelligence.

Applicability and transferability of the results:

The research is still in its infancy, there are only a few papers globally that tackle this approach. The proposed strategies apply especially in unstructured environments where manipulation is required.

Research team

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DESIGN OF MULTIFUNCTIONAL PLATFORM BASED ON NANOCOMPOSITES FOR ENVIRONMENTAL AND SENSING APPLICATIONS (NANOPLAT-SENV)

Goal of the project

The NANOPLAT-SENV project scope is to develop new bifunctional composite materials characterized through perovskite structure for the sensing applications and advanced water treatment technologies. These materials will enable to detect electrochemically the cytostatics in water and also, to develop photocatalytic treatment processes for emerging pollutants-containing water treatment.

Short description of the project

A new and economic method for in situ obtaining of multifunctional nanocomposites was developed.

Implementation period

01.02.2020 - 15.06.2020

Budget

47.600 RON (10000 EUR)

Amperometric detection of capecitabine

Main activities

The main work packages and tasks are:

1. Project management;

2. Obtaining of new composites based on perovskite-type oxides;

3. Characterization of nanomaterials with perovskite structure on carbon support;

4. Evaluation of adsorption and photocatalysis capacity of the composite materials selected for cytostatics removal/ degradation and correlation with the physico-chemical characterization;

5. Evaluation of electroanalytical activity of the selected composite materials for the elaboration of a method for electrochemical detection of the cytostatics from water;

6. Dissemination of the results.

Results

Lots of nanomaterials: LaFeO3, LaCoO3, CuCo2O4, CdCr2O4, CuBi2O4
Detection of CCB using LaFeO3/BDD electrod
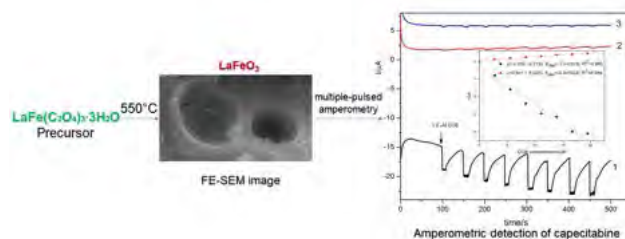
Applicability and transferability of the results:

The obtained nanocomposites were used for:

• development of sensors characterized by enhanced electroanalytical performance for cytostatics detection (e.g., doxorubicin, capecitabine, etc.);

• integration of VIS-based photocatalysis as advanced water treatment process related to the removal of cytostatics from water.

Research team

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CULTURAL AND PROFESSIONAL VALUES OF STUDENTS IN ROMANIAN TECHNICAL UNIVERSITIES

Goal of the project

The research aims to outline the iGeneration (iGen) profile – namely the profile of student population of Romanian technical universities - from the perspective of their values, of the way they perceive, learn, validate and use the media culture, as well as of their personal and professional expectations under the influence of the media culture

Short description of the project

Identifying the values and expectations of the young generation aspiring to an engineering career in the digital society.

Implementation period
01.02.2020 - 31.07.2020

Budget
47.600 RON (10000 EUR)

Main activities

• Theoretical and empirical objectives:

1. Identification of consumption routines of students at technical universities regarding the media culture (practices and platforms) from the point of view of the shared cultural, citizen and professional values

2. Determining students' expectations regarding the labour market and their own vocational training

3. Defining strategies for negotiating the meaning of media messages

4. Outlining the socio-professional value profile of the (I-Gen) student at a Romanian technical university

Activities:
1. Designing the survey tools and applying them online
2. Visiting university centres for data collection
3. Creating a database
4. Disseminating the results by publishing articles and participating in national and international conferences

Results

• 2 questionnaires were created and applied online
• over 3600 questionnaires were completed in 5 technical universities
• a database with representative samples for each university was created
• the 6 scientific articles were published:

• 3 articles are included in the ISI database:
   – 2 in VIRTUAL LEARNING - VIRTUAL REALITY, ICVL 2019, Bucharest University Press, ISSN: 1844-8933, WOS: 000506084800053
   – 1 in the BRAIN-LUMEN JOURNAL, Broad Research in Artificial Intelligence and Neuroscience - vol.no.10 / issue no. 4/December 2019
• the team members participated in 5 international conferences:
   1. Professional Communication and Translation Studies Conference, 4-5 April 2019 Timişoara
   2. Scientific Methods in Academic Research and Teaching, 7th Edition, Buşteni & Sinaia, Romania, 3-5 May 2019
   3. The International Conference PR-Trend Cluj-Napoca, 19.09-21.09.2019
   4. The 14th International Conference on Virtual Learning, ICVL 2019, 25 -26.10.2019, Bucharest
   5. 6th SWS International Scientific Conference Social Sciences 2019 24.08 - 2.09.2019, Albena, Bulgaria

Applicability and transferability of the results:

TThe obtained results helped to establish connections bewteen domains, so that they allow the Romanian technical universities to issue forecasts regarding the graduates' behaviour in relation to the media consumption and the labour market.

The publication of the research results will take into account ARUT's specificity in the Romanian educational landscape, paving the way for extensive research on the relationship among technical universities, labour market and digital revolution.

Research team

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